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ABSTRACT

To meet the need for advanced placement (AP) calculus instruction in Virginia schools faced with a teacher shortage and small enrollments, the Virginia Department of Education in cooperation with schools and television stations is developing a high technology advanced placement credit course. The course has eight components: (1) teleconferences/workshops to inform and initiate interaction with course developers; (2) a program handbook providing specific lesson information for students; (3) twenty linear television lessons on important calculus topics; (4) five interactive video programs using microcomputers and videocassettes; (5) independent computer diskette programs; (6) a teacher's guide to accompany the television programs; (7) a textbook and four ancillary manuals; and (8) a non-credit in-service course for teachers, offered during the summer. Using the handbook as the main assignment reference, the student reports at a scheduled hour for independent study; assistance is provided by an identified teacher contact if necessary. Periodic tests are administered; final evaluation is the Advanced Placement Calculus test of the College Board. Summative research for evaluating the project is being conducted. (MNS)

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AP CALCULUS FOR SCHOOLS WITHOUT AP CALCULUS TEACHERS

Departments of Education are faced with a shortage of teachers of mathematics. This shortage is not short-termed. Teachers of mathematics, espcially advanced math course teachers, are being lured to more lucrative positions in business and industry. In small school districts, the problem is magnified by the fact that there are too few qualifying students to merit the employment of a full-time teacher even if a teacher were available. The impact is being felt by students who fear rejection by schools of engineering and science because they lack transcript credits in courses such as calculus. Feedback from applicants is already indicating that rejections are being issued.

A statewide survey conducted by the Virginia Department of Education revealed the need for advanced placement calculus instruction as a growing concern among school officials and Department of Education curriculum specialists. To meet the need, the Department of Education, in cooperation with the schools and WCVE/WCVW-TV, is developing a high technology advanced placement credit course in calculus for use initially in the Fall, 1984.

The Course

The course, designed to match the advanced placement program of the College Board for AB Calculus, has eight components: (1) teleconferences/workshops, (2) program hand-

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book, (3) twenty linear television lessons, (4) five interactive video programs, (5) independent computer diskette programs, (6) a teacher's guide to accompany the television programs, (7) a textbook and four ancillary manuals, and (8) a non-credit in-service course for teachers.

Teleconferences and workshops were conducted to inform interested curriculum administrators, mathematics teachers, guidance counselors and superintendents about the project and to provide an opportunity for interaction with course developers. Presenters were the two calculus camera teachers, the computer programmer, a Department of Education representative, the executive producer, and the project director. Questions following the statewide broadcast teleconference related to logistics, student identification, costs of materials, requirements for building-level assisting teachers, and performance evaluation. Division-level workshops focus on special school needs.

The program handbook provides specific lesson information for the student. It is the core resource of the entire program. All components are cross-referenced. Assignments for each chapter are carefully sequenced.

Television lessons designed, taught and evaluated by mathematics specialists and calculus teachers complement textbook lessons. Topics chosen for television lessons are: (a) limits, (b) continuity, (c) the derivative, (d) applications of the derivative, (e) the definite integral, (f) ap-

plications of integration, (g) exponential functions, (h) logarithmic functions, (i) trigonometric functions, (j) integration of parts, and (k) a summary lesson on limit techniques. The number of lessons under the topics vary from one to five depending upon which subtopic developers felt the medium of television could address best.

The five interactive video programs, with branching, are designed for use on an Apple II Plus or Apple IIe microcomputer, and a Sony or Panasonic VHS video cassette player and monitor. The two units are interfaced by a BCD Associates interface board. Applications of the limit theory, applications of maxima and minima, applying area problems, solids of revolution: applied problems, and integration techniques are the subjects of the programs. The software is in the form of a floppy disk and a one-half-inch video cassette.

The independent computer diskettes are programs submitted by students and teachers who participated in a contest sponsored by the developers. Other calculus diskette programs were selected from public domain programs.

Designed specifically for the mathematics teacher serving as the building contact for students, the teacher's guide gives the objective and a description for each television program. Additionally, there is a listing of human and print resources.

Swokowski's Elements of Calculus with Analytic Geometry was selected as the text because "its topics", according to the author, "cover fully and extend beyond the topics required by the Committee on Mathematics of the Advanced Placement Program of the College Board for Calculus AB examinations." The text also includes additional topics recommended in the syllabus of the College Board Advanced Placement Course Description for Mathematics. The text was selected also because members of the advisory committee felt it was best for the program. Other support texts are: (a) Complete Solutions Manual, (b) Teacher's Manual, (c) Student Guide to Accompany Swokowski's Elements of Calculus with Analytic Geometry, and (d) Supplemental Tests with Solutions for the Student Guide to Accompany Swokowski's Elements of Calculus with Analytic Geometry.

Teacher Training

Because one objective of the project is to upgrade teacher skills in calculus, the non-college credit in-service course is offered during the summer. The course utilizes 18 of the 20 student programs, the overview program, and the interactive computer/video programs in combination with independent study for teacher training. The non-credit course is also taken as a refresher course by the building-level teacher contact.

A model for the in-service course, provided to schools,

recommends independent work by the teacher at the controls of the computer. The interactive programs provide exposure to instructional computer programming techniques and afford an opportunity for the teacher to interact, at a meaningful level, with the computer. The program also provides an opportunity for training in a non-threatening atmosphere.

Procedure for Use

All seven student components are housed in the school's mathematics department. Using the handbook as the main assignment reference, the student reports at a scheduled hour, for independent study. The handbook provides specific instructions on material selection, procedure, requisite theory, and practice in solving of problems. However, assistance, when needed, is provided by the identified building teacher contact. Should more specialized help be required, the building contact has a list of external resources.

Student Evaluation

To help the student pace and monitor his work, periodic tests are administered. Tests are scored by the building-level teacher contact who also advises the student of strengths and weaknesses. Final evaluation is the Advanced Placement Calculus test of the College Board. Satisfactory performance on this test qualifies the student for transcript credit.

Project Evaluation

Under development is the project's summative research. The research agency is the Bureau of Educational Research, University of Virginia. A major part of the study will be relegated to those 20 school divisions with a limited number of qualifying students and no available AP calculus teacher. A second part of the study with other divisions will involve schools that have calculus teachers desirous of using the course because they lack teaching experience and/or feel the course provides beneficial resources. Results are expected during the Summer, 1985.

Conclusion

Educators overall, like those in Virginia, recognize that employment of qualified teachers for advanced mathematics will continue to be a challenge. They also recognize that continued economic constraints will necessitate pooled resources across school division boundaries to meet some instructional needs. This program may well be a promising practice and a model for replication in other states.

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June, 1984